## AD NUMBER

**AD872273**

## NEW LIMITATION CHANGE

TO

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FROM

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## AUTHORITY

**USATEC, ltr, 14 Dec 1970.**

3 June 1970

Materiel Test Procedure 7-1-004
Aberdeen Proving Ground



U. S. ARMY TEST AND EVALUATION COMMAND
BACKGROUND DOCUMENT

ARMY AIRCRAFT ARMAMENT

1. INTRODUCTION

Combat operations in undeveloped countries such as Vietnam must rely extensively on Army aircraft, especially helicopters, which, together with appropriate armaments, provide ample firepower and aerial mobility. In the jungle environment, this combination of increased aerial firepower and aerial mobility permits rapid closure with the enemy by troops that are not fatigued by travel.

At present, there are many applications of armament systems to Army rotary wing aircraft, comprising weapons and ammunition of recent design together with synchronized sighting, mounting, and firing devices that provide for weapon elevation, depression, and traverse. Types of armament systems now standard for field use are divided into three categories: suppression-fire weapons (machine guns), point target weapons (SS-11 antitank missiles), and area target weapons (2.75-inch rockets, mines, munitions and grenades). They are installed as appropriate in selected aircraft and most are operable either in flight or on the ground. For practical purposes Army aircraft with weapons may be assumed to be limited to helicopters.

Testing of Army aircraft armament systems involves testing of the aircraft, the armement to be installed, the munition or warhead and the combination regarded as a system. The aircraft must first be evaluated for performance, stability, and control by itself, then with its assigned armament load and with other envisioned loads and external stores. An envelope of permissible operations under each of these conditions must be established and a corresponding safety-of-flight release issued by the responsible agency before the weapon system engineering test begins. A variety of armaments may be involved, including grenade launchers, machine guns, munition dispensers, missiles, and rockets. Each must be tested initially on the ground to evaluate performance, environmental effects, stresses on the aircraft and the reliability of the weapon-ammunition combination as one component of the aircraft armament system. Most tests must be repeated aloft and further developed to evaluate fire control components along with overall accuracy and dispersion-of-fire characteristics under representative tactical situations.

2. FACILITIES AND TEST EQUIPMENT

Generally, the equipment required to conduct aircraft armament tests as a minimum consists of the armament subsystem with fire control, the aircraft, and flight and firing crew. Additionally, a suitable firing range with ammunition handling facilities, landing area, air-to-ground radio communication, and standby fire-fighting equipment are required for overall safety.

*Supersedes Interim Pamphlet 20-15.

Any additional instrumentation equipment required on the armament subsystem, the aircraft, or on the ground to obtain, as an example, aircraft space position as a function of time will depend on the test objectives and the engineering type data required for each specific test task. In this connection refer to MTP's 3-1-003, 3-2-045, 3-2-821, and 3-2-824.

3. TEST PLANNING

An Army aircraft armament subsystem is composed of three parts: The Weapon. Typical of the weapons are machine guns, grenade launchers, rocket launchers, missile launchers, mine dispensers, and munition dispensers.

The Ammunition. This consists of the device, usually containing an explosive, that is launched by the weapon. Typical of these are small arms bullets, grenades (both hand grenades or barrel-launched, projectile-like grenades), rockets, guided missiles, mines, munitions, and supplies. Some may be launched as canisters.

The Fire Control System. This consists of the sighting and aiming device, the controls, the computer (for certain subsystems) and the operator.

In many cases, the weapon and ammunition that are employed are adapted to the aircraft after having initially been developed for a different purpose. In such cases, much of the weapon and ammunition testing will have already been performed in connection with the earlier development, and the test director should fully consider the data already available when planning his test. The test director may find, for example, that the safety evaluation of the ammunition has already been conducted, or that endurance tests of a weapon have already been performed. In other cases, weapons and ammunition specifically designed for a helicopter will be required to undergo the full gamut of tests.

In planning an aircraft weapon subsystem test, it is necessary to refer to many MTP's. First, the test director selects the MTP referring to his particular subsystem. These include:

Rockets - MTP 7-2-009
Machine guns - MTP 7-2-010
Missiles - MTP 7-2-011
Mines, grenades, canisters, munitions, provisions - MTP 7-2-013
Multiple armaments - MTP 7-2-014

The above MTP's will direct him to others which include:

On-board test instrumentation - MTP 7-1-003
Fire control - MTP 7-2-502
Air-to-ground accuracy and dispersion - MTP 7-2-503
Maintenance evaluation - MTP 7-2-504
Human factors - MTP 7-2-505

Since the subsystem may invoke ammunition and weapons that are of the

type often found in connection with infantry or armor operations, much of the information required for planning a complete test of an aircraft weapon subsystem is found in the MTP's of Volumes III and IV, the important ones being contained in the references of this MTP.

4. REVIEW OF WEAPON INFORMATION

The test director reviews available literature and drawings pertaining to the test item. He familiarizes himself with the operating features of the armament subsystem and determines whether engineer design tests have revealed conditions that should be further investigated. At the same time, he determines whether safety features stated in the QMR's and technical characteristics (TC) have been incorporated and whether any special procedures are required to eliminate test hazards.

5. CHARACTERISTICS DATA SHEET

A characteristics data sheet consists of a general photograph of the test item shown mounted to the helicopter, reduced in size and combined, on a glossy 8- x 10-inch print, with all principal physical and performance characteristics of the weapon. It is used in the formal report and serves many other general uses. Sometimes two photographic views are required and placed on one glossy photograph to properly show the weapon. The official nomenclature is placed directly beneath the photograph(s) and above the data; it is used as the title. Appropriate available data, some major elements of which are listed below, are recorded on the characteristics data sheet.

5.1 BELT-AND MAGAZINE-FED AUTOMATIC WEAPONS

| | |
|---|---|
| Weapon | Mount |
| Caliber | Aircraft to which mounted |
| Weight | No. of weapons per aircraft |
| Without magazine | Weight of mount |
| With magazine empty | Type of fire control |
| With magazine loaded | Ammunition |
| Weapon length | Muzzle velocity |
| Barrel length | Range |
| Type of rifling | Types of ammunition |
| Rate of fire | Types of fuzes |
| Belt or magazine load | Weight |

| | |
|---|---|
| Type of ammunition belt | Arming mechanism |
| Maximum elevation | |
| Maximum depression | |
| Maximum traverse | |

5.2 ROCKET AND MISSILE LAUNCHERS

| Weapon | Mount |
|---|---|
| Diameter of launcher | Aircraft to which mounted |
| Weight, empty | No. of weapons per aircraft |
| Weight, loaded | Weight of mount |
| Number of tubes | Type of fire control |
| Width, overall | |
| Height, overall | Ammunition |
| Maximum elevation | Types of ammunition |
| Maximum depression | Types of warheads |
| Maximum traverse | Weight of ammunition |
| Firing mechanism | Rate of fire |
| | Range (minimum and maximum) |
| | Dispersion |
| | Type fuze |
| | Burning time |
| | Burning distance |
| | Method of stabilization |
| | Arming mechanism |

5.3 DISPENSERS OF MINES, MUNITIONS, OR SUPPLIES

| Dispenser | Mount |
|---|---|
| Weight, empty | Aircraft to which mounted |

| Dispenser | Mount |
|---|---|
| Weight, loaded | No. of weapons per aircraft |
| Number of units | Weight of mount |
| Type of dispenser | Type of fire control |
| Method of powering dispenser | Weight of fire control |
| | Major components of fire control |
| Width, overall | |
| Maximum elevation | Ammunition or Supplies |
| Maximum depression | Types |
| Maximum traverse | Weight of each unit |
| Firing mechanism | Combat load |
| Rate of fire | Type fuze |
| Velocity of fire | Fuze delay |
| Range (minimum and maximum) | Method of stabilization |
| | Arming mechanism |

## 6. SAFETY CONSIDERATIONS

### 6.1 SAFETY STATEMENT AND SAFETY-OF-FLIGHT RELEASE

Before conducting engineer design or engineering tests, the test agency should receive from the developer a safety statement or an interim safety statement that will be used to develop safe operating procedures as prescribed in USATECOM Regulation 385-6. In addition, before any aerial activity is performed by a test agency, the agency must receive a safety-of-flight release from the U. S. Army Aviation Systems Command (AVSCOM).

### 6.2 MINIMUM HAZARD AMMUNITION

In conducting tests of aircraft weapons, the minimum amount of propellant and explosive is used consistent with the requirements for obtaining test data. This means that, in most cases, testing will be performed with inert warheads and live propellants. The complete test sequence, which may be condensed for certain weapon systems, is as follows:

a. Ground Tests from Test Stand

1) Ammunition completely inert - used for exercising and checking out the subsystem.
2) Propellant live, fuze inert, warhead inert - used for firing tests of weapons.
3) Propellant live, fuze live with spotter charge, warhead inert - used for accuracy and dispersion tests.
4) Propellant live, fuze live, warhead live - used only for assuring safety.

b. Ground Tests from Helicopter (usually with rotor turning).

Same as a (1) through (4).

c. Aerial Tests.

Same as a (1) through (3).

6.3 SAFETY EVALUATION

The safety evaluation is a portion of the engineering test that is conducted before service testing in order to establish a reasonable assurance that the test item can be service tested, at locations that include the climatic test sites, with a minimum of risk to personnel. A successful safety evaluation permits an aircraft Safety Release by USATECOM, as defined in USATECOM Regulation 385-6. Most data for the safety evaluation are obtained from the early portion of the suitability (engineering) test, but all appropriate data from the engineer design test are also used. A separate safety evaluation is also normally made a part of the initial production test to meet the requirements of USAMC Regulation 700-34.

The safety evaluation encompasses three phases: the prefiring phase, the ground-firing phase and the aerial-firing phase. In general the prefiring phase consists of: a study of the safety statement obtained from the developer (paragraph 6.1), an examination of the design of the test item to uncover possible safety problems, a review of prior testing including engineer design tests conducted by the developer of the item and similar items, and an examination of the item for adequacy of manufacture. Physical measurements and static loading are part of this phase, as is an evaluation of the electrical system (MTP 3-2-503).

The ground-firing phase for the safety evaluation will include as a minimum the extreme temperature tests (+145° or +160°F and -50° F); operational vibration; humidity tests; ground-to-ground firing for safety, durability, and reliability; and ground-to-ground firing for aircraft comptability.

With a safety-of-flight release (paragraph 6.1) and ground-firing data on hand, aerial-firing tests can be conducted.

The aircraft is flown and the armament system evaluated by firing

ammunition at various speeds and maneuvers. As in the ground test, the weapons are oriented to extreme firing conditions. Appropriate tests for compatibility of weapon subsystem with the aircraft are selected from paragraph 7 and the compatibility evaluated. Recommendations pertaining to Safety Release are made in accordance with USATECOM Regulation 385-6.

## 7. COMPATIBILITY OF WEAPON SUBSYSTEM AND AIRCRAFT

In testing a helicopter armament subsystem, there are certain special considerations that must be evaluated that are pertinent to the weapon-aircraft interface. Some of these are:

a. Gas concentrations inside aircraft from weapon firing.
b. Noise levels at crew stations during weapon firing.
c. Pattern of cases and links ejected under various flight conditions.
d. Effects of weapon firing vibration on the helicopter and on the fire control system.
e. Effects of muzzle blast on the adjacent structure of the aircraft.
f. Extent of powder pitting plastic windows or corroding aircraft structure.
g. Possible interference of firing trajectory with rotor.
h. Effect of weapon firing on flight and stability of the aircraft.
i. Effect of weapon firing on adjustment of the automatic flight controls.
j. Effect of traversing and elevating of the flexible-mount guns on the stability of the aircraft and effect of flight on the operation of the flexible-mount guns.
k. Adequacy of the field of view for search.
l. Smoothness of operation and controllability of flexible mounts.
m. Adequacy of space for operating crew, limitation of crew movement, suitability of normal provisions for entrance and exit.
n. Satisfactoriness of functioning of guns and associated components at test altitudes, required attitudes, and speeds.
o. Maximum aircraft accelerations (positive and negative) at which flexible mounts and their guns and associated equipment continue to function satisfactorily.
p. Suitability of sight installation with regard to comfort of operating crew member in sighting position with sight at all attitudes of elevation, depression, and traverse.
q. Satisfactoriness of location of flexible-mount controls, firing controls, and charging controls.
r. Effect of inherent helicopter vibration on weapon firing and fire control.
s. Suitability of provisions for hiding flash at night.
t. Adequacy of communication equipment provided for operating crew members under combat conditions.
u. Effect of total weapon system power consumption on the operation of other helicopter equipment.
v. Adequacy of fire interrupters and contour devices.

## 8. ENVIRONMENTAL TESTS

For testing under the various environmental conditions, the aircraft armament systems are usually mounted on suitable test stands and placed in an environmental chamber for exposure. The standards for climatic environmental conditions are drawn from AR 70-38. Other military standards, such as MIL-STD-810, as well as the MTP's listed in the references, may be used for specific tests. For most cases, the climatic and mechanical environmental testing of aircraft armament will be restricted to the following tests:

a. High temperature
b. Low temperature
c. Sand and dust test (MTP 3-2-045)
d. Humidity test (MTP 4-2-820)
e. Salt spray test (MIL-STD-810, Method 509)
f. Fungus-resistance test (MTP 4-2-818)
g. Rain test (MTP 3-2-059)
h. Vibration test (MIL-STD-810, Method 514)

All armament subsystems will be suitable for use under intermediate hot-dry, intermediate cold, wet-warm and wet-hot climatic conditions as defined in AR 70-38. They may be made suitable for use under cold, extreme cold, and hot-dry climatic conditions by application of kits as required. The subsystems should be resistant to deleterious effects of fungus, sand, salt water, rust, and corrosion during use and storage. In addition, human engineering factors should be evaluated for all aspects of design that influence operation and maintenance of the system. All functions of the system should be operable when personnel are wearing winter flight clothing.

## 9. REFERENCES

A. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing, 6 May 1969.
B. AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions, 1969.
C. MIL-STD-810, Environmental Test Methods.
D. MTP 3-1-003, Meteorological Data.
E. MTP 3-2-030, Grenades.
F. MTP 3-2-045, Machine Guns.
G. MTP 3-2-059, Hand and Shoulder Weapons.
H. MTP 3-2-503, Safety Evaluation of Electrical and Electronic Equipment.
I. MTP 3-2-618, Electrical Power Measurements for Weapon Subsystems.
J. MTP 3-2-821, Ballistic Data for Boosted Projectiles.
K. MTP 3-2-824, Flight Tests of Antitank Missiles.
L. MTP 4-2-015, Close Support Rockets and Missiles.
M. MTP 4-2-502, Safety Evaluation, Mines and Associated Demolition Devices.
N. MTP 4-2-503, Safety Evaluation, Close Support Rockets and Missiles.
O. MTP 4-2-505, Mines and Demolitions.

P. MTP 4-2-818, Testing for Fungus Resistance.
Q. MTP 4-2-820, Humidity Tests.
R. MTP 6-2-140, Integrated Aircraft Instrumentation.
S. MTP 7-1-003, Helicopter Armament Test Instrumentation.
T. MTP 7-2-009, Aircraft Rocket Subsystems.
U. MTP 7-2-010, Aircraft Machine Gun Subsystems.
V. MTP 7-2-011, Aircraft Guided Missile Subsystems.
W. MTP 7-2-013, Mine and Munitions Dispensing Subsystems.
X. MTP 7-2-014, Aircraft Multiple Armament Subsystems.
Y. MTP 7-2-502, Aircraft Fire Control Evaluation.
Z. MTP 7-2-503, Air-to-Ground Accuracy and Dispersion.
AA. MTP 7-2-504, Maintenance Evaluation of Aircraft Weapons.
AB. MTP 7-2-505, Human Factors in Aircraft Weaponry.

UNCLASSIFIED
Security Classification

**DOCUMENT CONTROL DATA - R & D**

*Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)*

| | |
|---|---|
| 1 ORIGINATING ACTIVITY (Corporate author)<br>US Army Test and Evaluation Command (USATECOM)<br>Aberdeen Proving Ground, Maryland 21005 | 2a. REPORT SECURITY CLASSIFICATION<br>Unclassified<br>2b. GROUP<br>---------- |

3 REPORT TITLE
US Army Test and Evaluation Command Materiel Test Procedure 7-1-004, Background Document, - "Army Aircraft Armament."

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)
Final

5 AUTHOR(S) (First name, middle initial, last name)
----------

| 6 REPORT DATE | 7a. TOTAL NO. OF PAGES | 7b. NO. OF REFS |
|---|---|---|
| 3 June 1970 | 12 | 28 |

| 8a. CONTRACT OR GRANT NO. | 9a. ORIGINATOR'S REPORT NUMBER(S) |
|---|---|
| DA-18-001-AMC-1045(R)<br>b. PROJECT NO<br>AMCR 310-6<br>c.<br>d. | MTP 7-1-004<br>9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)<br>---------- |

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| 11 SUPPLEMENTARY NOTES | 12. SPONSORING MILITARY ACTIVITY |
|---|---|
| ---------- | Headquarters<br>US Army Test and Evaluation Command<br>Aberdeen Proving Ground, Maryland 21005 |

13 ABSTRACT

This Background Document provides general testing information relative to the planning and Conduct of Army Aircraft Armament engineering evaluation. This information supplements and is applied in common to test procedures which deal with the evaluation of specific aircraft armament items

DD FORM 1 NOV 65 1473 (PAGE 1)
S/N 0101-807-6811

UNCLASSIFIED
Security Classification

A-31408

UNCLASSIFIED
Security Classification

| KEY WORDS | LINK A | | LINK B | | LINK C | |
|---|---|---|---|---|---|---|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| Armament | | | | | | |
| Army Aircraft Armament | | | | | | |
| Test Procedures | | | | | | |

DD FORM 1 NOV 65 1473 (BACK)

UNCLASSIFIED
Security Classification